# Internet of Things with Big Data, Cloud and M2M Technologies

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**Overview**

Internet of Things may be a network of physical objects that may act with one another to share info and take action. The term was initially planned by Kevin Sir Frederick Ashton in 1999. The idea of IoT first became in style at the Auto-ID center, MIT. IoT may be pronounced as Machine to Machine (M2M) technology. For IoT, variety of billions of connected devices is associate indicator of IoT. The property is simply associate enabler however the $64000 worth of IoT is on information (business insight/data-driven economy). For Big Data, data collection is one in all the most considerations and IoT will play vital roles for data collection and data sharing. For Big Data, data collection is nothing while not real business worth insight. Cloud offers everything as a Service business model for IOT and big data. IoT may be a King, big data may be a Queen and Cloud may be a Palace.

1. **INTRODUCTION**

   IoT has major impact on the life of humans as it proceeds to the next level of web. The IoT is basically a web that extended in providing inter-connectivity, communication and networking between electronic devices and physical entities (objects or "Things"). The Internet of Things (IoT) is that the network of physical objects — devices, vehicles, buildings and alternative things embedded with natural philosophy, software, sensors, and network connectivity — that allows these objects to gather and exchange information. The technologies and solutions that alter integration of universe information and services into the present networking technologies.

   1. **Survey of the Use of IoT**

      200 technology and business professionals responsible for IoT projects. The ultimate aim of the survey is to understand the impacts of utilizing the data captured by the devices that make the interconnectivity of devices i.e., Internet of Things and focused on the latent potential of IoT data. The main use of IoT for Business Optimization: 53% are using IoT projects to optimize their existing businesses and 47% as a strategic business investment, Target audiences for IoT solutions include consumers (42%), business (54%) and internal use by employees (51%).

   2. **IOT & data challenges**

- 44% said that data was large and cannot be analysed effectively.
- 36% said that data was difficult to capture.
- 25% said that reliability is missing with the captured data.
- 19% saying that data was slowly captured and pertains to be useless.
- Once data is captured, 27% said they weren't able to find the outcomes of the data captured.
- Much like data capture, 26% said that the analysis process takes more time to be actionable.
- 24% said that business processes were too rigid to utilize the gathered information from the data (even if the information has been crunched on time).
- Ease of use of the product seems to be an issue rather than cost for many IoT stakeholders.
- More participants (76%) said that they will collect and store more data if it is easier to do so rather than asking it for free.

2. **IOT WITH BIGDATA**

Big data value chain consists of the following phases: Collection, Ingestion, Discovery & Cleansing, Integration, Analysis and Delivery. It is shown in the figure 1.

**Collection** – Structured, unstructured and semi-structured data from multiple sources
**Incorporation** – loading vast amounts of data onto a single data store
**Discovery & Cleansing** – understanding format and content; clean up and formatting
**Integration** – linking, entity extraction, entity resolution, indexing and data fusion
**Analysis** – Intelligence, statistics, predictive and text analytics, machine learning
**Delivery** – querying, visualization, real time delivery on enterprise-class availability


**Figure 1: Big data value chain**

1. **Considerations for Big Data Standardization**
   - Variety of Use Cases
   - Mobility
   - Security & Privacy
   - Lifecycle Management & Data Quality
   - System Management & Other Issues
   - Data Characteristics
     - It is either Distributed or Centralized
     - The 4 Vs: Volume, Velocity, Variety, Veracity

- Data Collection
- Data Visualization
- Data Quality
- Data Analytics & Action

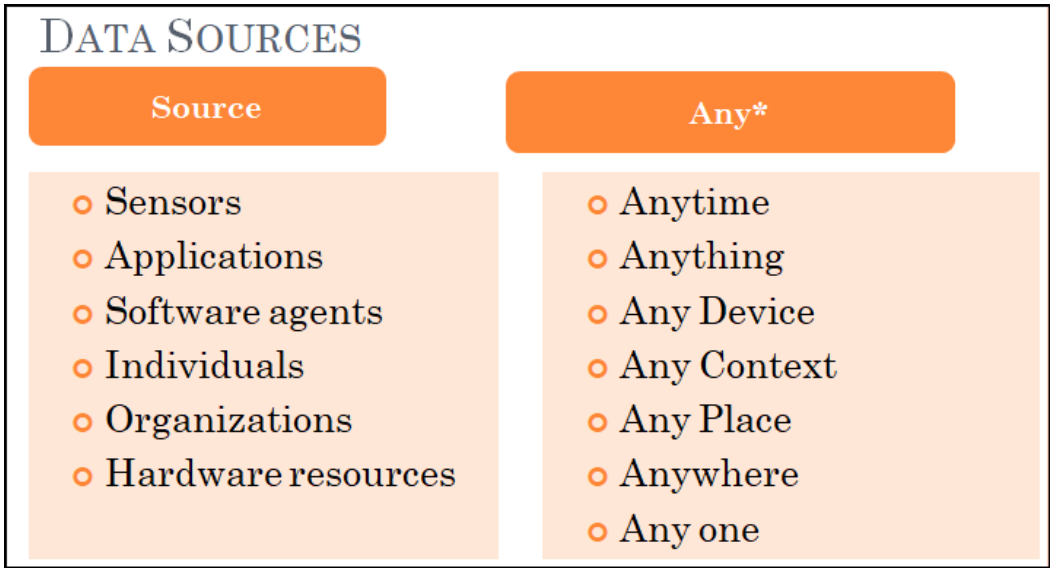


**Figure 2: Data Sources for Big Data**

2. **Big Data or IoT?**

   Every minute, we send 0.204 billion emails, generate 0.018 million Facebook likes, send 2.78lakhs tweets, and upload 2 lakh photos to Facebook. (BIG DATA)

   12 million RFID (radio-frequency identification) tags (used to track the physical movements of the objects in real world by capturing data) were sold in 2011. By 2021, it's estimated this number will increase to 209 billion as IoT takes off.

   The growth of IoT results in the increase in number of devices that connect to internet from 13 billion (today) to 50 billion (by 2020)

   Big Data industry is expected to increase its revenue from US $10.2 billion in 2013 to about US $ 54.3 billion by 2017.

3. **IOT WITH CLOUD**

   Shared pool of configurable computing resources (Internet infrastructure called a platform). On-demand network access (Using the Internet for communication and transport provides hardware), software and networking services to Clients. It is

provisioned by the Service Provider.

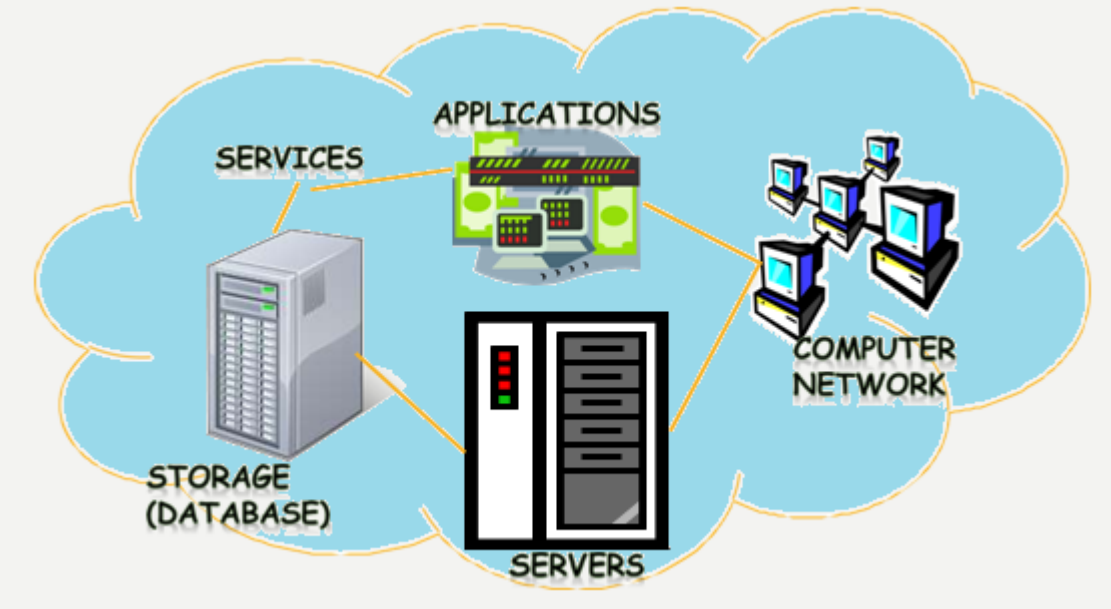


**Figure 3: Cloud Computing**

To create new and innovative applications, IoT interconnects billions of devices, sensors, and real time objects. In order to support these applications, a trusted, versatile and agile platform is essential. One such platform is Cloud Computing. Cloud computing is an architecture that manages various technology capabilities such as:

- multi-tenancy,
- automated provisioning and
- usage accounting while relying on the Internet and
- other connectivity technologies like
- richer Web browsers to realize the vision of computing delivered as a utility.

Three commonly deployed cloud service models namely:

- Infrastructure as a Service (IaaS)
- Platform as a Service (PaaS) and
- Software as a Service (SaaS)

In IaaS, the access to the hardware such as sensors and actuators are given to the consumers. Consumers can set up arbitrary services and manage the hardware via cloud resource access control.

PaaS can provide a platform from the customer can access the IoT data and customize it

according to the IoT applications being developed by the consumer.

SaaS can be provided with PaaS as the base to offer the provider's own SaaS platform for characteristic IoT domains.

**Companies such as:** Axeda18, ThingWorx19, DeviceWise20 - are already providing software development platform to build innovative M2M and IOT applications.

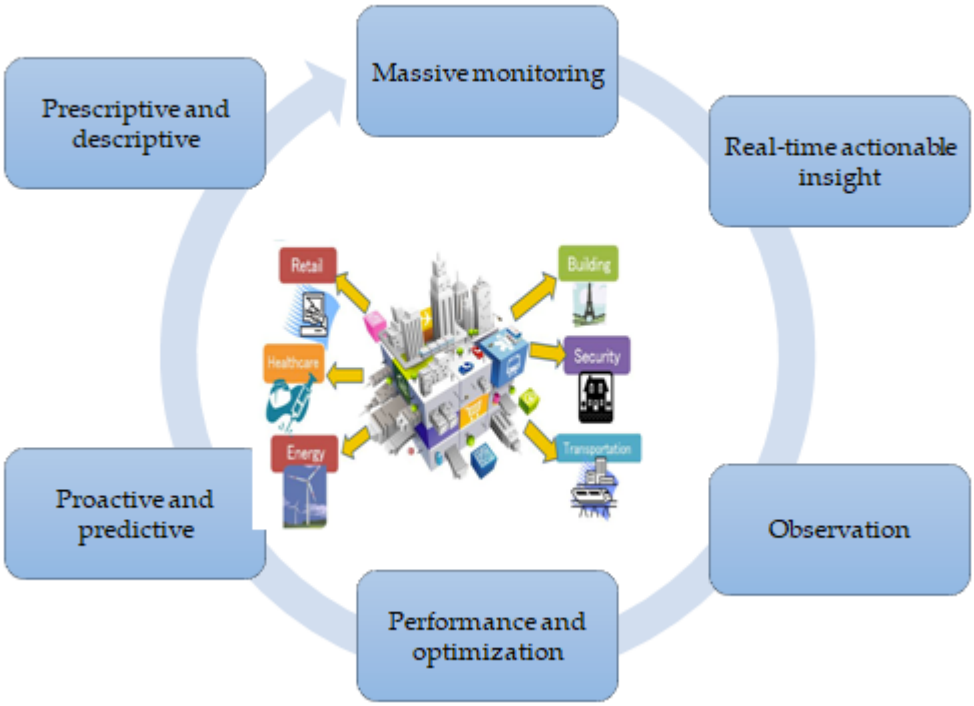


**Figure 4: Cloud-based IoT Big Data applications**

1. **Key features of clouds to support the IoT**

Several features available in clouds are requirements of resource-constrained objects:

- Flexibility of resource allocation
- More intelligent applications
- Energy saving
- No on-site infrastructure
- Heterogeneity of the smart environment
- Scalability and agility
- Virtualization

4. **IOT WITH M2M**

M2M (Machine-to-Machine Applications) (to be more precise, Mobile to Machine and Machine to Mobile communications) is an emerging area in telecom technologies. It is an augmented behavior. M2M, IoT are acronyms created by tinkers who are trying to create new trends even without understanding the user needs. M2M is the communication between two or more entities that need not have any direct human intervention. M2M uses a device (sensor) to capture an 'event' (temperature), which happens through a network (wireless, wired or hybrid) to an application (software program). And also, it converts the captured event into meaningful information (e.g., items need to be restocked).

1. **Components of M2M:**

The following components are used: M2M device, M2M are a network and M2M Gateways.

M2M Device is a device that runs M2M capable application(s) and network domain functions. M2M Device is either connected directly to an Access Network or interfaced to multiple M2M Gateways via an M2M Area Network.

M2M Area Network is an area network provides inter connectivity between M2M Devices and M2M Gateways.

Examples of M2M Area Networks include:

- Personal Area Network technologies such as: IEEE 802.15, SRD, UWB, Zigbee, Bluetooth, etc. or
- local networks such as PLC, M-BUS, Wireless M-BUS.

M2M Gateways - Equipment's using M2M Capabilities to ensure whether the M2M Devices are working and interconnected to the Network and Application Domain. The M2M Gateway may also run M2M applications.

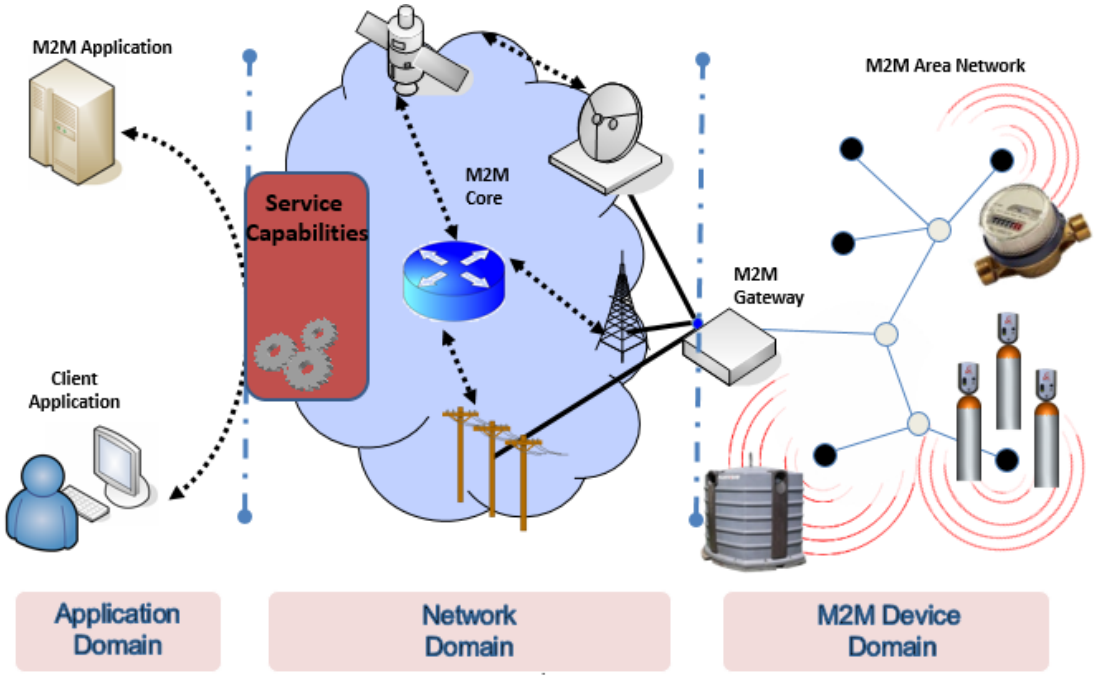


**Figure 5: M2M Architecture**

## 5. INTEGRATION OF CLOUDS, BIG DATA CONSIDERING THE IOT

Data will be stored in “Cloud”. Data can be accessible anywhere by the users and their devices. Data can also be shared with others.

1. **Combining clouds and the IoT**
   - To support required resources to be accessed by new gen objects
   - To meet the dynamical computational requirements of the ecological applications with prevailing sensor network technologies

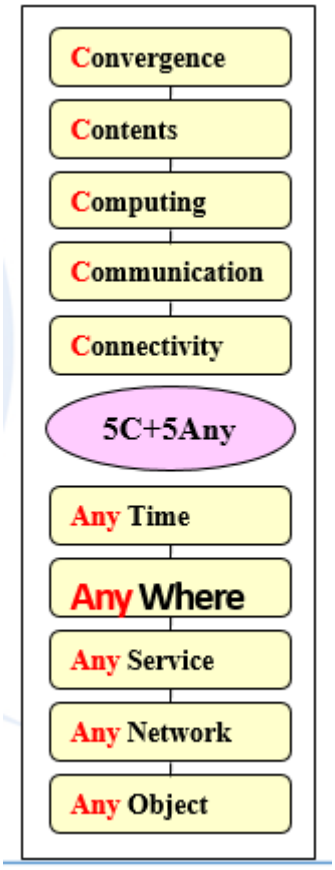


**Figure 6: 5C and 5Any**

2. **Benefits**
   - The cloud can work on behalf of the object for
     - increasing accessibility,
     - sustaining performance and
     - scalability.
   - The cloud can support resource continuity so that objects move freely changing access technologies while using resources from the same cloud.

6. **CONCLUSION**

IoT, Big data, Cloud and M2M are the future of the world. IoT is an element of a smarter environment that can be used in combination with M2M communication and cloud services. Large protection and data collection and processing of the data are possible. The secure data transport, less bandwidth utilized, quicker response, minor battery usage and it will work well in latency network too are added advantages. This enables devices to communicate status and information, which in turn can be collected, improved and interconnected internally or onwards to other units. The use of the data in new and useful ways and IoT can be revolutionized.

The cloud-based IoT service environment combines the cloud computing, big data and the IoT. The main aim is to proficiently support various services using cloud and analytics technologies from different kinds of objects (e.g., devices, machines, etc.). The relevant calibration efforts for realization of the cloud-based IoT need to be fast-tracked with special consideration of their commercial feasibility.

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## ABOUT THE AUTHOR

Dr. S. Balakrishnan is a Professor and Head in Department of Computer Science and Business Systems at Sri Krishna College of Engineering and Technology, Coimbatore, Tamilnadu, India. He has 17 years of experience in teaching, research and administration. He has published over 15 books, 3 Book Chapters, 14 Technical articles in CSI Communications Magazine, 1 article in Electronics for You (EFY) magazine, 3 articles in Open Source for You Magazine and over 100 publications in highly cited Journals and Conferences. Some of his professional awards include: Contributors Competition Winner July 2019 by Data Science Foundation with cash prize of £100, 100 Inspiring Authors of India, Deloitte Innovation Award - Cash Prize Rs.10,000/- from Deloittee for Smart India Hackathon 2018, Patent Published Award, Impactful Author of the Year 2017-18. His research interests are Artificial Intelligence, Cloud Computing and IoT. He has delivered several guest lectures, seminars and chaired a session for various Conferences. He is serving as a Reviewer and Editorial Board Member of many reputed Journals and acted as Session chair and Technical Program Committee member of National conferences and International Conferences at Vietnam, China, America and Bangkok. He has published more than 6 Patents on IoT Applications.

# About the Data Science Foundation

The Data Science Foundation is a professional body representing the interests of the Data Science Industry. Its membership consists of suppliers who offer a range of big data analytical and technical services and companies and individuals with an interest in the commercial advantages that can be gained from big data. The organisation aims to raise the profile of this developing industry, to educate people about the benefits of knowledge based decision making and to encourage firms to start using big data techniques.

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